SB761
.U7I5
87-5

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

FOREST PEST MANAGEMENT

3420
Report 87-5
April 1987

STATE & PRIVATE FORESTRY

INTERMOUNTAIN REGION

THE 1986 WESTERN SPRUCE BUDWORM CONDITIONS IN THE INTERMOUNTAIN REGION AND FORECASTS FOR 1987

by
K.A. Knapp and P.J. Mocettini[1]

ABSTRACT

Based on aerial detection surveys, host trees on approximately 3.1 million acres of forest land in the Intermountain Region were visibly defoliated by western spruce budworm (WSBW) during 1986. Acreage of observed defoliation increased on the Grand Teton National Park; the Boise, Caribou, Dixie, Payette, Salmon, Sawtooth, and Wasatch-Cache National Forests also had increased defoliation. A decrease in acreage of defoliation was noted on the Bridger-Teton, Challis, Fishlake, and Targhee National Forests. Acreage with moderate and heavy defoliation remained near 1985 levels while acreage with light defoliation increased over 1985 levels.

To verify defoliation occurrence and to forecast WSBW activity during 1987, field evaluations were conducted on the Boise, Payette, Salmon, Sawtooth, and Targhee National Forests in southern Idaho. Based on these evaluations, a moderate decrease in defoliation intensity should occur on all Forests sampled.

Field observations were made to verify aerial observations for other areas surveyed. Evaluations for predicting defoliation in 1987 were not made in these areas.

Specific location and intensity of 1986 WSBW activity as well as activity forecast for 1987 are discussed.

INTRODUCTION

Acreage of conifers visibly defoliated by western spruce budworm (WSBW), Choristoneura occidentalis Freeman, has been documented for southern Idaho Forests since 1952 (Table 1). Defoliation has resulted in incremental growth loss, varying degrees of topkill and understory mortality (Beveridge and Cahill 1984).

Currently to assist land managers in identifying intensity and extent of existing infestations, aerial detection surveys of National Forests, other forested federal, and adjacent state and private lands in the Intermountain Region are conducted by Forest Pest Management (FPM) (Beveridge and Knapp 1984). Additionally field evaluations to project WSBW activity and to verify aerial observations are conducted on National Forests which have substantial infested acreage. Field observations to verify aerial observations are normally made on Forests where population sampling is not conducted.

[1]Biological Technicians, USDA Forest Service, Intermountain Region, Forest Pest Management, Boise, Idaho

LIBRARY COPY
ROCKY MT. FOREST & RANGE
EXPERIMENT STATION

Table 1. Acres of defoliation by western spruce budworm in the Intermountain Region from 1952 through 1986.

Year	Total Acres*	State			Source of Information
		Idaho	Utah	Wyoming	
1952	1,000,000	1,000,000			Johnson & Denton
1953	500,000	500,000			1975
1954	1,000,000	1,000,000			"
1955	1,175,000	1,175,000			"
1956	1,127,500	1,127,500			"
1957	1,172,940	1,172,940			"
1958	974,710	974,710			"
1959	499,000	499,000			"
1960	516,000	516,000			"
1961	1,425,000	1,425,000			"
1962	1,641,000	1,641,000			"
1963	1,632,000	1,632,000			"
1964	2,296,000	2,276,000	20,000		"
1965	1,515,100	1,495,100	10,000	10,000	"
1966	992,200	958,400		33,800	"
1967	218,700	163,900	100	54,700	"
1968	505,500	395,300	400	109,800	"
1969	544,400	463,200	400	80,800	"
1970	307,720	239,200	120	68,400	"
1971	373,900	343,300		30,600	"
1972	562,300	500,300		62,000	USDA Forest Service
1973	224,100	224,100			1972 - 1986
1974	357,800	338,500	400	18,900	"
1975	733,400	614,200		119,200	"
1976	696,400	555,200		141,200	"
1977	696,800	644,200		52,600	"
1978	1,115,400	915,800		199,600	"
1979	1,260,200	1,113,200		147,000	"
1980	1,512,300	1,248,400		263,900	"
1981	1,412,400	1,228,200	50,100	134,100	"
1982	2,513,400	2,258,000	51,500	203,900	"
1983	2,784,600	2,375,500	62,700	346,400	"
1984	2,347,200	2,032,700	137,400	177,100	"
1985	2,906,500	2,620,400	87,600	198,500	"
1986	3,137,100	2,904,900	95,600	136,600	"

* Does not include defoliation in wilderness and primitive areas 1975-1986

METHODS

Regionwide aerial detection surveys to detect WSBW and other insect activity were conducted on a drainage-by-drainage basis from low-flying fixed-wing aircraft during July and August. Most forested lands in the Intermountain Region (except lands within wilderness areas, alpine areas, and other non-commercial lands) were surveyed. Location of three intensity classes of defoliation (light, moderate, and heavy) were mapped as described by Beveridge and Knapp (1984).

A WSBW pupae case sampling system, developed by USDA Forest Service, Pacific Northwest Forest and Range Experiment Station scientists, and modified by FPM, was used to evaluate populations and potential for defoliation of susceptible hosts over general areas. During late August and early September, the system was employed on the Boise, Payette, Sawtooth, Salmon, and Targhee National Forests in southern Idaho. Sample point selection was based on accessibility, presence of host type, and aerially observed defoliation. Pupae case counts were made at 250, 18, 19 and 47 points in 1985 and at 216, 14, 18, and 43 points in 1986 on the Boise/Payette, Sawtooth, Salmon, and Targhee National Forest respectively.

At each point pupae cases on one 45 cm long, lower crown branch from each of 12 randomly selected host trees were counted. Pupae case counts from each tree sampled at each point were summed and the values used to forecast defoliation in 1987 as follows:

Pupae Case Count	Percent Defoliation Predicted	Defoliation Classification Predicted
1-4	1-50%	light-moderate
5+	50%+	heavy

Also at each sample point the current year defoliation was evaluated by visually estimating the percentage of defoliation present in each of the 12 trees sampled for pupae. Using these values defoliation was classified as follows: less than 25 percent defoliation=light; 25 percent to 50 percent=moderate; more than 50 percent=heavy.

In other areas with WSBW defoliation, field observations of extent and intensity of defoliation were made by FPM during routine field evaluations. These observations were used to verify aerial detection survey information. No attempt to predict future defoliation intensity was made.

RESULTS AND DISCUSSION

Based on the aerial detection surveys, hosts on approximately 3.1 million acres of Forest land in the Intermountain Region were defoliated by WSBW during 1986 (Figure 1, Table 2). Compared to defoliation in 1985, this is an increase of nearly 230,000 acres and the largest amount of defoliation observed in the past 35 years.

Defoliation classified as light increased 40 percent, to 749,881 acres, while defoliation classified as moderate and heavy remained relatively static at 1,002,300 acres and 1,384,000 acres respectively (Table 2).

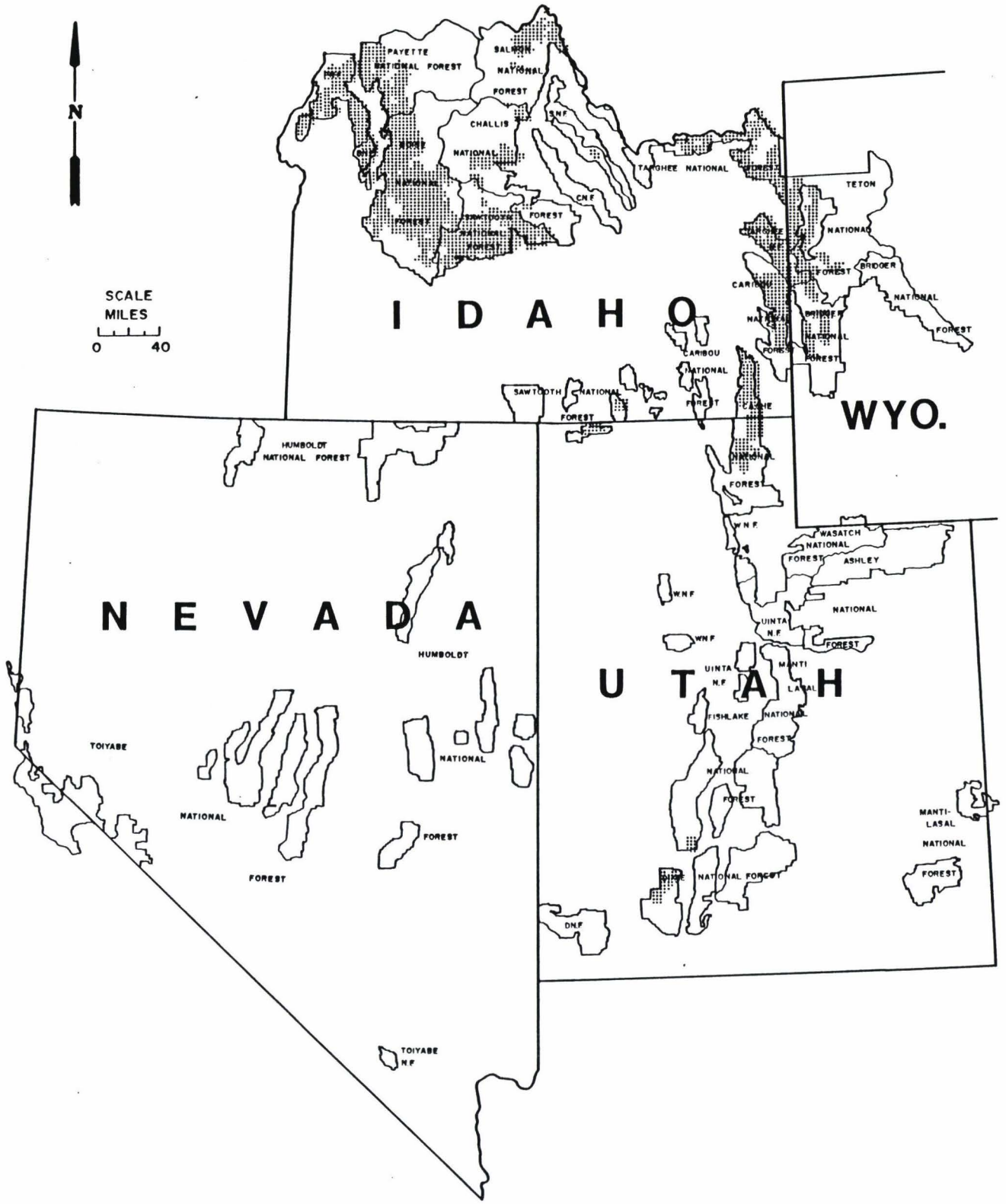


Figure 1. Western spruce budworm activity in the Intermountain Region during 1986.

Table 2. Acres of defoliation by western spruce budworm in the Intermountain Region during 1985-86 as determined by aerial detection surveys.

Forest (and Adjacent Land)*	Year	Defoliation Intensity				Change (From 1985)
		Light	Moderate	Heavy	Total	
Boise	1986	76,875	302,216	754,614	1,133,705	+ 151,804
	1985	101,236	403,835	476,830	981,901	
Bridger-Teton	1986	98,410	12,723	584	111,717	- 86,814
	1985	183,517	15,014	0	198,531	
Caribou	1986	47,018	141,105	88,795	276,918	+ 91,764
	1985	0	61,035	124,119	185,154	
Challis	1986	32,571	2,258	0	34,829	- 65,399
	1985	46,374	39,951	13,903	100,228	
Dixie	1986	6,347	9,071	12,019	27,437	+ 6,333
	1985	4,277	9,077	7,750	21,104	
Fishlake	1986	5,031	0	0	5,031	- 7,244
	1985	10,911	1,364	0	12,275	
Grand Teton N.P.	1986	23,071	1,622	137	24,830	**
	1985	**	**	**	**	
Payette	1986	61,768	193,957	362,550	618,275	+ 90,635
	1985	81,195	166,105	280,340	527,640	
Salmon	1986	29,580	0	0	29,580	+ 15,191
	1985	14,389	0	0	14,389	
Sawtooth	1986	60,667	162,788	131,336	354,791	+ 19,389
	1985	25,593	122,994	186,815	335,402	
Targhee	1986	266,839	171,437	18,583	456,859	- 18,804
	1985	55,446	79,126	341,061	475,663	
Wasatch-Cache	1986	41,704	5,195	16,207	63,106	+ 8,880
	1985	9,726	28,133	16,367	54,226	
Southern Idaho totals	1986	575,318	973,761	1,355,878	2,904,957	+ 284,610
	1985	324,233	873,046	1,423,068	2,620,347	
Utah totals	1986	53,082	14,266	28,226	95,574	+ 7,969
	1985	24,914	38,574	24,117	87,605	
Wyoming totals	1986	121,481	14,345	721	136,547	- 61,984
	1985	183,517	15,014	0	198,531	
R-4 totals	1986	749,881	1,002,372	1,384,825	3,137,078	+ 230,595
	1985	532,664	926,634	1,447,185	2,906,483	

* Portions of some Forests are not surveyed annually, therefore actual acreage of defoliation may be substantially higher on these Forests.

** Not surveyed in 1985

Pupae case counts and defoliation intensity forecast for 1987 are displayed in Table 3. In 4 out of the 7 drainages sampled on the Boise/Payette National Forests defoliation intensity observed in 1986 was higher than predicted by 1985 pupae counts, whereas in the other 3 drainages the opposite was true. Over the entire area however observed defoliation was close to that predicted. On the Salmon, Sawtooth, and Targhee National Forests defoliation intensity observed in 1986 was less than predicted by 1985 pupae counts. As can be seen in Table 4 predictions of defoliation intensity seldom are the same as actual defoliation observed in individual areas. However, over large areas, predictions are as accurate as those obtained using other methods, considerably less expensive to obtain, and adequate for our purposes of verifying WSBW occurrence and predicting general defoliation patterns for the following year.

Following is a brief summary of aerially observed conifer defoliation by WSBW during 1986 in the Intermountain Region and what to expect for 1987. Total acreage of defoliation for each year from 1965 through 1986 and acreage of defoliation by intensity class for 1985 and 1986 are graphically depicted for each unit surveyed in Figures 2-13.

Table 3. Defoliation by WSBW predicted for 1987 based on pupae case counts.

Area Sampled	Total Points Sampled	Predicted Defoliation Intensity	
		Light/Moderate (0-50%)	Heavy (+ 50%)
Boise and Payette National Forests*			
Little Salmon River	25	22	3
Mores & Grimes Creeks	18	11	7
Weiser River	49	46	3
North Fork Payette River	56	51	5
South Fork Payette River	30	28	2
Deadwood River	17	16	1
North & Middle Fork Boise River	21	17	4
Total	216	191	25
Sawtooth National Forest			
South Fork of Boise River	14	13	1
Salmon National Forest			
Salmon, North Fork & Cobalt Ranger Districts	18	14	4
Targhee National Forest			
Dubois Ranger District	18	18	0
Island Park, Ashton, Palisades, Teton Basin Ranger Districts	25	23	1
Total	43	41	1
Total - Southern Idaho	291	259	31

*The Boise and Payette National Forests are grouped together because of the many common drainages.

Table 4. Comparision of defoliation predicted for 1986 using 1985 pupae case counts with actual defoliation observed at sample sites. Predictions made in 1985 for 1986 defoliation are in parenthesis. Results are expressed as a percentage of total points sampled in each area.

Area Sampled	Total Points Sampled		Defoliation Intensity			
			Light/Moderate		Heavy	
	1986	1985	1986	1985	1986	1985
Boise and Payette National Forests*						
Little Salmon River	25	36	12%	(56%)	88%	(44%)
Mores & Grimes Creeks	18	22	50%	(23%)	50%	(77%)
Weiser River	49	53	29%	(55%)	71%	(45%)
North Fork Payette River	56	70	59%	(80%)	41%	(20%)
South Fork Payette River	30	19	73%	(80%)	27%	(20%)
Deadwood River	17	21	100%	(98%)	0%	(2%)
North & Middle Fork Boise River	21	29	57%	(7%)	43%	(93%)
Total	216	250	51%	(56%)	49%	(44%)
Sawtooth National Forest						
South Fork of Boise River	14	18	93%	(83%)	7%	(17%)
Salmon National Forest	18	19	100%	(68%)	0%	(32%)
Salmon, North Fork Cobalt R.D.						
Targhee National Forest						
Dubois Ranger District	18	20	100%	(80%)	0%	(20%)
Island Park, Ashton, Palisades, Teton-Basin R.D.'s	25	27	96%	(88%)	4%	(12%)
Total	43	47				
Total Southern Idaho	291	334	63%	(61%)	37%	(39%)

*The Boise and Payette National Forests are grouped together because of the many common drainages.

BOISE NATIONAL FOREST

Extent of defoliation by WSBW during 1986 increased moderately over 1985 levels. Hosts on approximately 1,133,700 acres were visibly defoliated in 1986; whereas, hosts on 981,000 acres were defoliated in 1985. Acreage of heavy defoliation increased significantly--approximately 754,000 acres of heavy defoliation were observed in 1986 compared to 476,000 acres in 1985. Acreage of light defoliation decreased from 101,000 acres in 1985 to 76,800 acres in 1986; moderate defoliation decreased from 403,000 acres to 302,000 acres over the same period. Group and single tree mortality was evident in Douglas-fir and grand fir stands in some heavily defoliated areas.

The West Mountains, North Fork Range, South Fork of the Payette River drainage, and the Mores Creek Summit-Beaver Creek Summit areas continue to sustain the most severe damage on the Forest. Areas of moderate defoliation were scattered thoughout the host type; whereas, in 1985 most areas of light defoliation were located on the southern portion of the Idaho City, Boise, and Mountain Home Ranger Districts.

Continued moderate to heavy defoliation is predicted throughout the Grimes Creek and Mores Creek drainages. Moderate defoliation is expected throughout the South Fork of the Payette River drainage; static to decreasing defoliation is forecast throughout the Deadwood River drainage. Since most susceptible host type is currently infested, large increases in defoliated acreage are not expected to occur on the Forest next year.

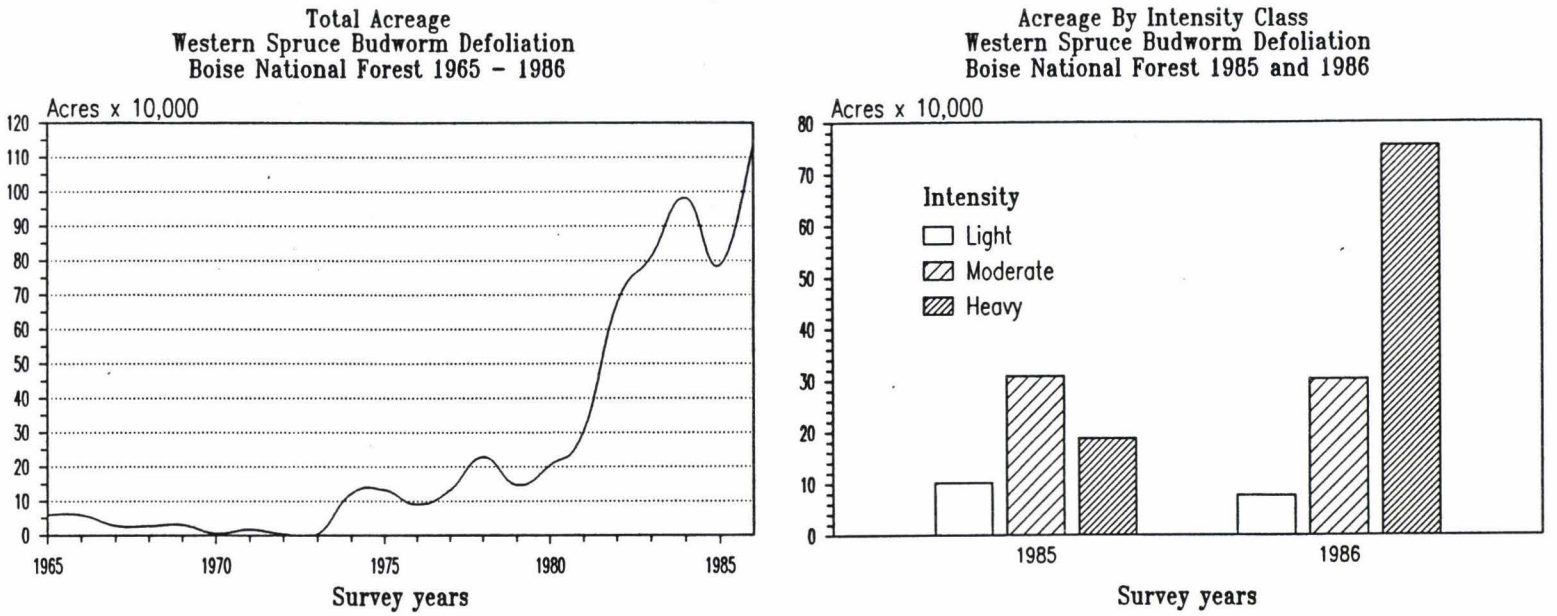


Figure 2. Western spruce budworm activity on the Boise National Forest.

BRIDGER-TETON NATIONAL FOREST

Defoliation extent and intensity continued to decrease on the Bridger-Teton National Forest with approximately 111,700 acres of defoliation observed in 1986. In 1985, 198,500 acres of defoliation were observed. Area with light defoliation decreased from 183,000 acres in 1985 to 98,400 acres in 1986; area with moderate defoliation decreased from 15,000 acres in 1985 to 12,700 acres in 1986. Heavy defoliation was not recorded on the Forest.

Light defoliation was concentrated along the Greys River drainage and throughout the Salt River Range on the Greys River Ranger District; light to moderate defoliation was located on the east slope of the Teton Mountains, along the Snake River Range, and along Granite Creek on the Jackson Ranger District. Population sampling was not conducted on the Forest during 1986.

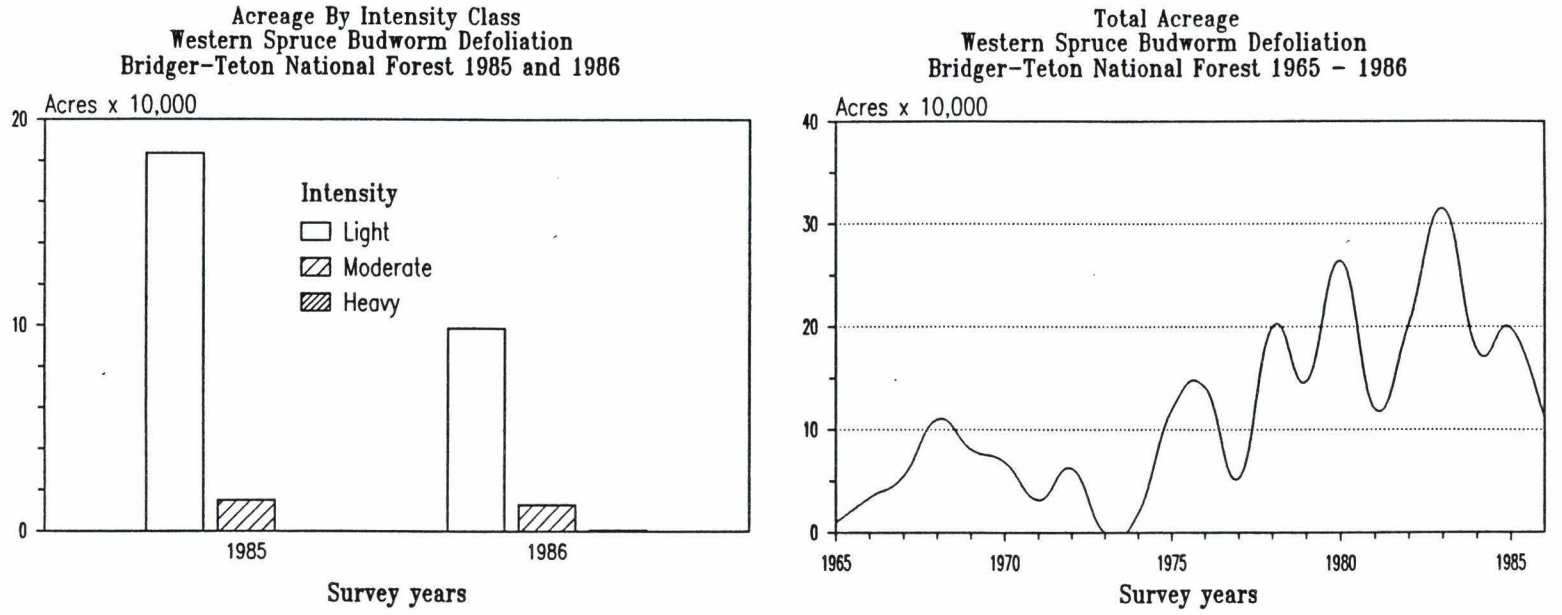


Figure 3. Western spruce budworm activity on the Bridger-Teton National Forest

CARIBOU NATIONAL FOREST

Douglas-fir and subalpine fir continued to be defoliated throughout all areas surveyed. Acreage of observed defoliation increased from 185,100 acres in 1985 to 276,900 acres in 1986. Much of this increase is attributable to an increase in acreage surveyed rather than an infestation expansion. Previously only areas north of Tincup Creek were surveyed. However during 1986 the Webster and Caribou Ranges were also surveyed.

Intensity of defoliation generally decreased Forestwide with most observed defoliation classified as moderate or heavy. Heavy defoliation continued to be located throughout Caribou Basin and Tincup Creek while light or moderate defoliation occurred near Palisades Reservoir and along the Webster Range. Topkilling and understory mortality were apparent in areas such as Caribou Basin where hosts have sustained several consecutive years of heavy defoliation.

It is known that WSBW infests portions of the Forest not normally covered during aerial surveys; therefore, actual acreages of defoliation are higher than reflected by our figures.

Population sampling was not conducted on the Forest during 1986.

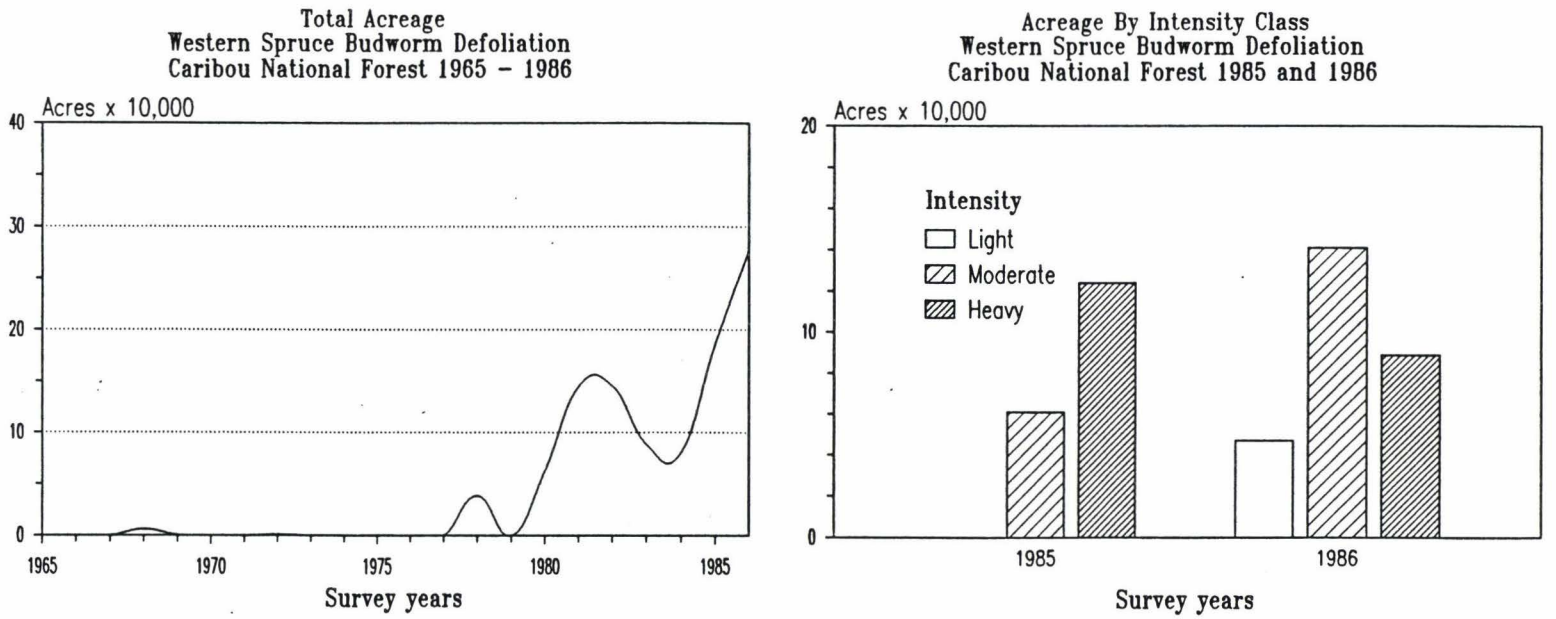


Figure 4. Western spruce budworm activity on the Caribou National Forest

CHALLIS NATIONAL FOREST

During the last several years, acreage of defoliation in areas surveyed has been highly variable. Hosts on 100,000, 615, and 88,000 acres were defoliated in 1985, 1984, and 1983, respectively. Defoliation in 1986 continued this up-and-down pattern with hosts on approximately 34,800 acres being defoliated.

Compared to 1985, defoliation intensity in 1986 generally decreased with only light and moderate defoliation being observed. Light to moderate defoliation was present throughout the Salmon River drainage from Basin Creek upstream to Lyon Creek and throughout the Morgan Creek drainage. Elsewhere, light defoliation was recorded along the North Fork of the Big Lost River and Little Lost River drainages. Actual acreage of defoliation may be higher than reported, since portions of the Forest are not surveyed on an annual basis.

Population sampling was not conducted on the Forest during 1986.

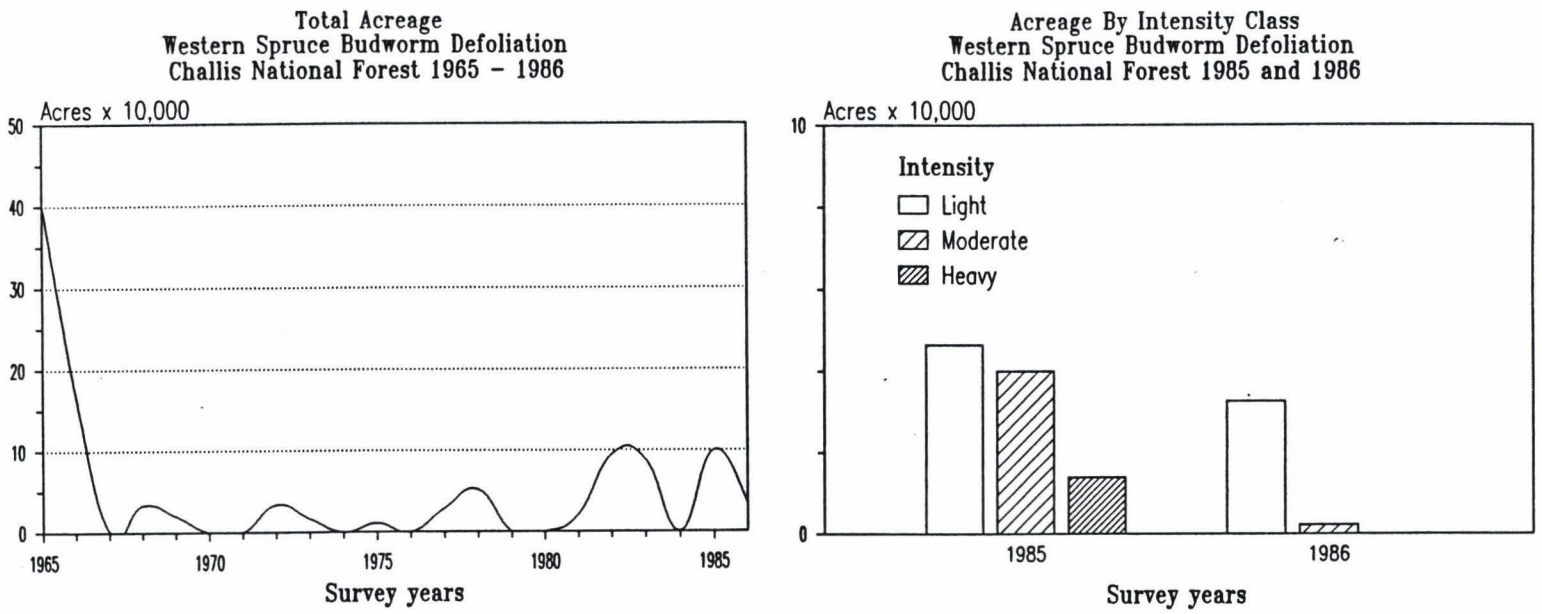


Figure 5. Western spruce budworm activity on the Challis National Forest

DIXIE NATIONAL FOREST

Acreage of WSBW activity increased with hosts on approximately 27,400 acres being visibly defoliated during 1986. This is an increase of 6,300 acres from 1985. Area of defoliation classified as light and heavy increased while area of defoliation classified as moderate remained near 1985 levels.

Defoliation was located east of Parowan from Brian Head north to Bear Valley on the Cedar City Ranger District. Heavy defoliation was concentrated in the Little Valleys area, around Grouse Peak, and near Yankee Meadows Reservoir. Light and moderate defoliation occurred throughout the infestation.

Population sampling was not conducted on the Forest during 1986.

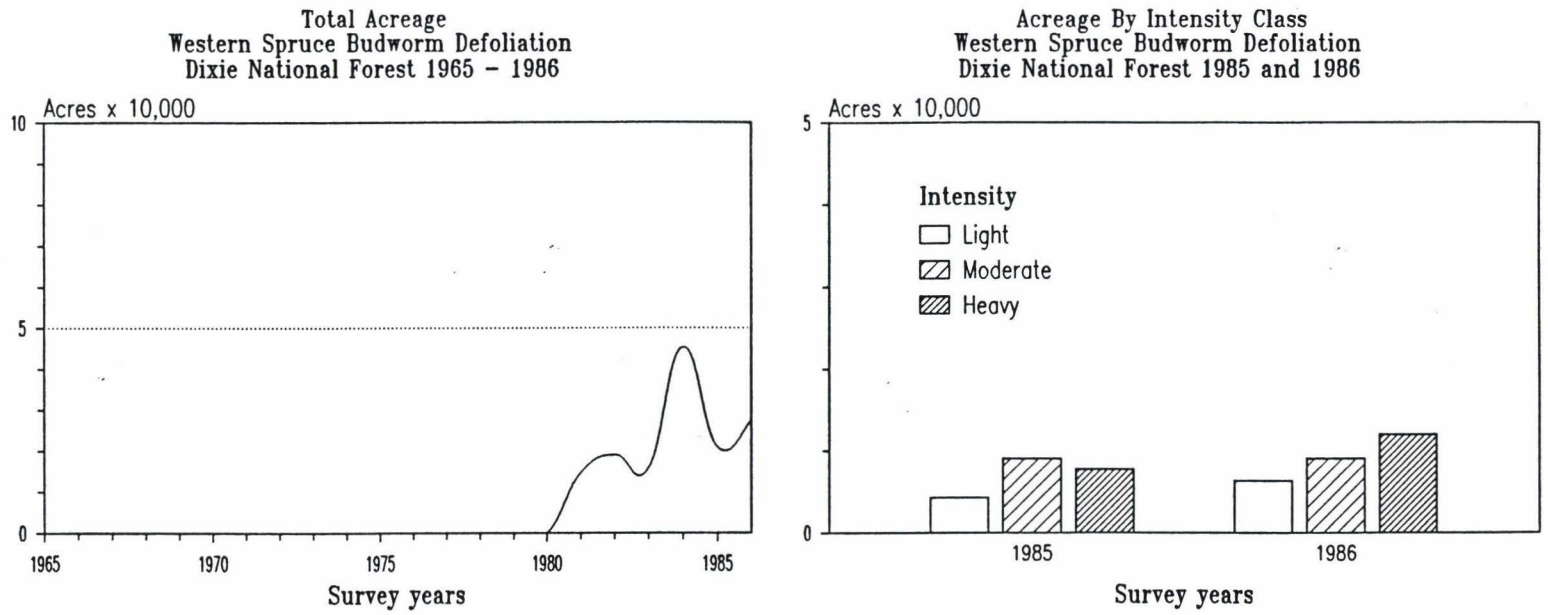


Figure 6. Western spruce budworm activity on the Dixie National Forest

FISHLAKE NATIONAL FOREST

Hosts on approximately 5,000 acres were visibly defoliated in 1986; whereas, hosts on approximately 10,000 acres were defoliated in 1985. All defoliation mapped was classified as light.

Defoliation was concentrated east of Beaver in the Beaver River drainage near Kents Lake, along the South Fork of Baker Creek, and along Thompson ridge.

Population sampling was not conducted on the Forest during 1986.

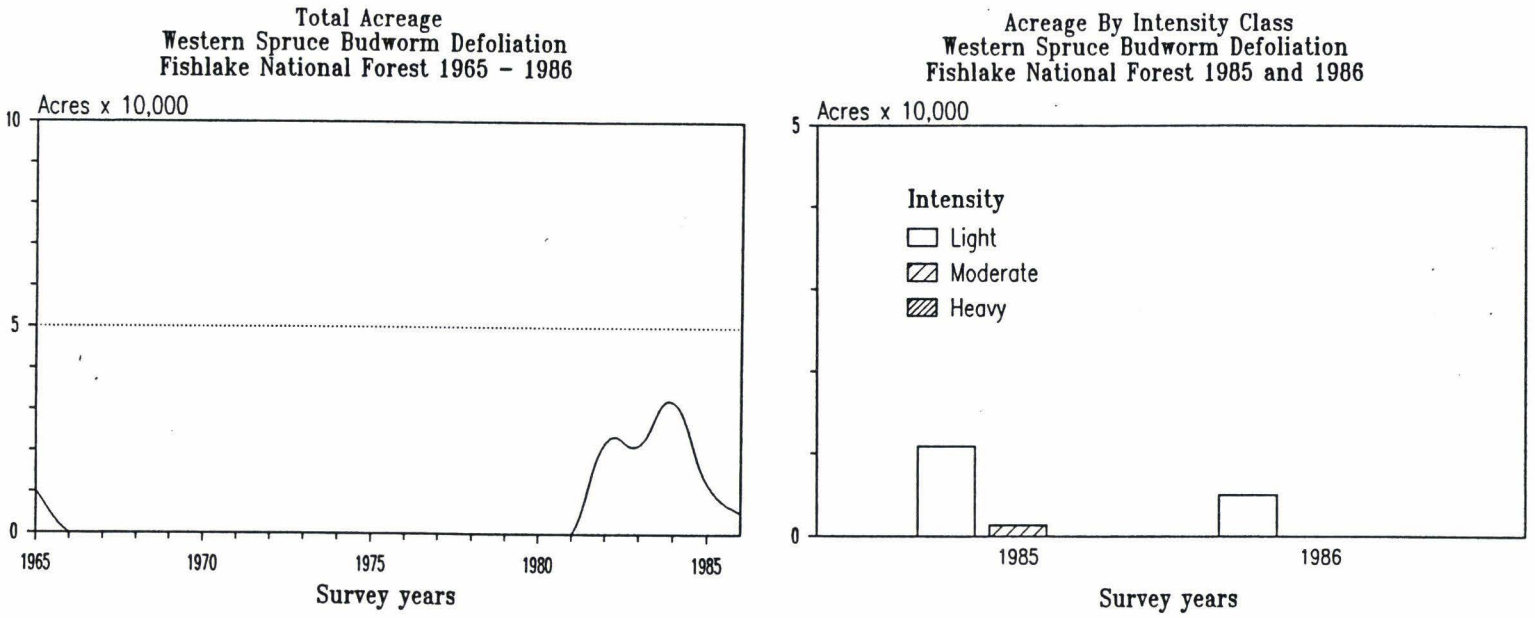
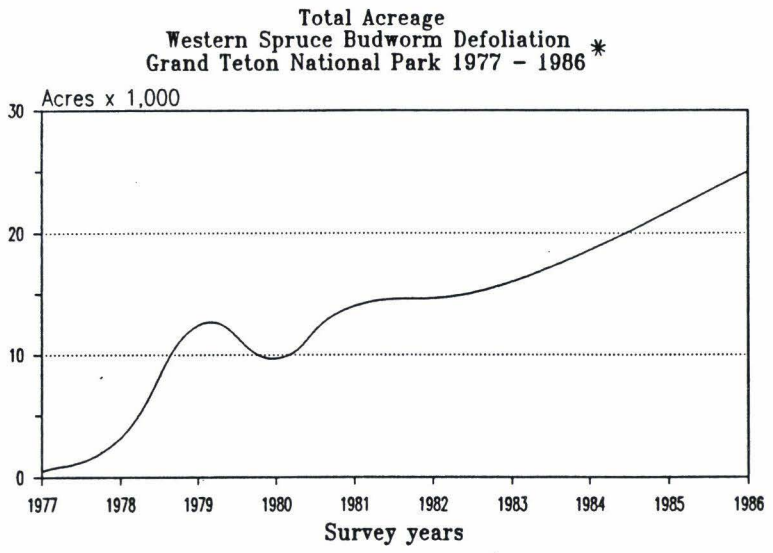


Figure 7. Western spruce budworm activity on the Fishlake National Forest

GRAND TETON NATIONAL PARK

Grand Teton National Park is surveyed every two or three years, unless more frequent surveys are requested. Since 1984, when the Park was last surveyed, acreage of defoliation has increased, while defoliation intensity has decreased. In 1986 Douglas-fir and subalpine fir on approximately 25,000 acres were visibly defoliated. Virtually all defoliation observed was classified as light.

Population sampling was not conducted in the Park during 1986.



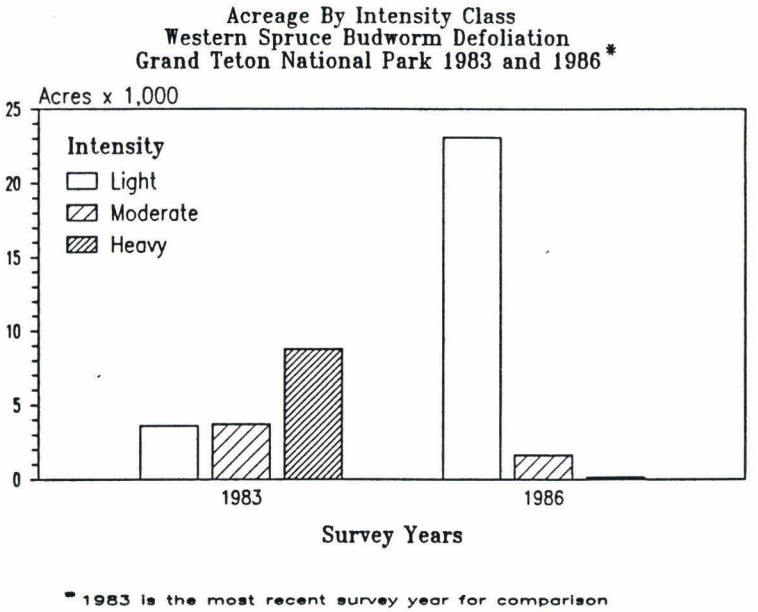


Figure 8. Western spruce budworm activity in Grand Teton National Park

PAYETTE NATIONAL FOREST

Hosts on approximately 618,000 acres were visibly defoliated during 1986; whereas hosts on approximately 527,000 acres were defoliated in 1985. Infestations increased in size along the French Creek, Elkhorn Creek, and Partridge Creek drainages in Douglas-fir, true fir, and spruce; along the West Fork of the Weiser River drainage in Douglas-fir and grand fir; and throughout the Cuddy Mountain and Hitt Mountain areas in mostly Douglas-fir.

Acreage of moderate and heavy defoliation increased while acreage of light defoliation decreased. Heaviest defoliation continued to occur throughout the West Mountains and along portions of the North Fork of the Payette River north of McCall. Elsewhere on the Forest, heavy defoliation was observed along the Middle and West Forks of the Weiser River drainage (Council and New Meadows Ranger Districts) and throughout the Cuddy and Hitt Mountains (Council and Weiser Ranger Districts). Areas of light and moderate defoliation were widely scattered throughout the Forest.

Population sampling indicates that defoliation intensity should generally decrease. Moderate decreases in defoliation intensity are predicted throughout the Little Salmon River drainage; static to decreasing defoliation intensity is predicted for the Weiser River and North Fork of the Payette River drainages.

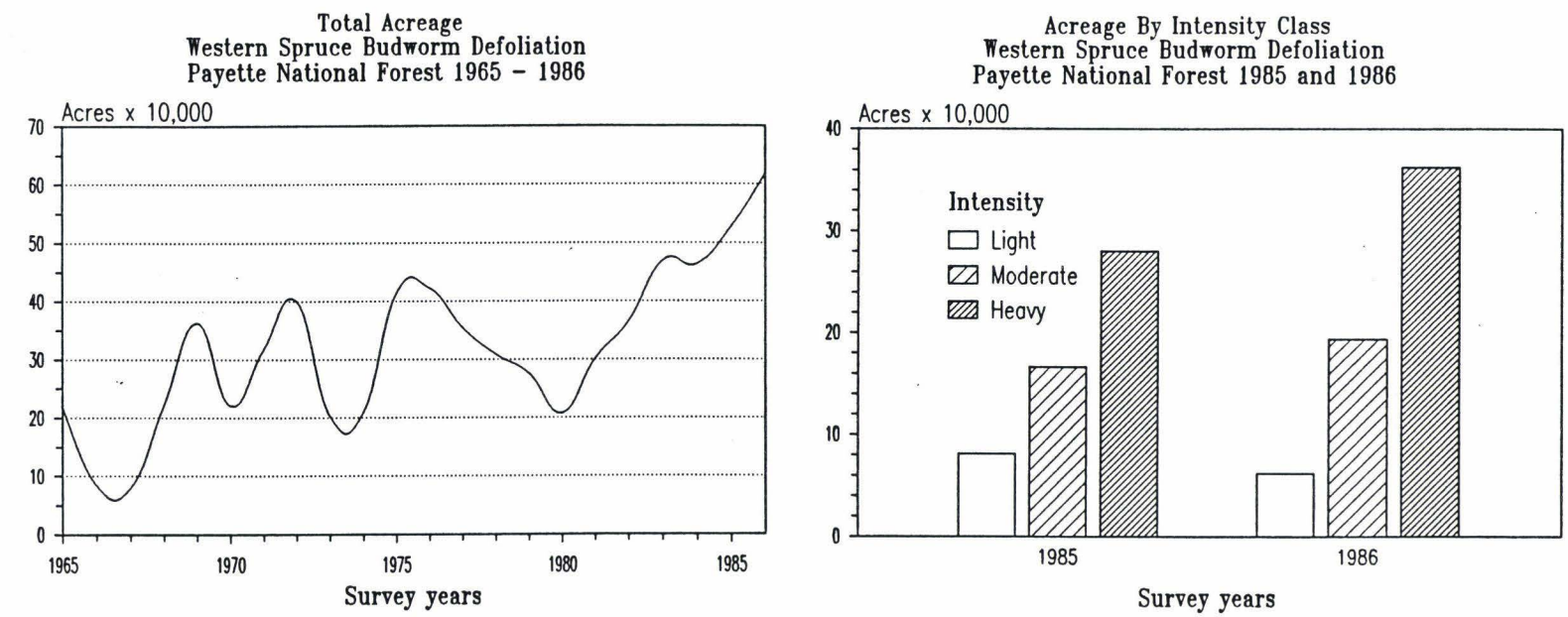


Figure 9. Western spruce budworm activity on the Payette National Forest

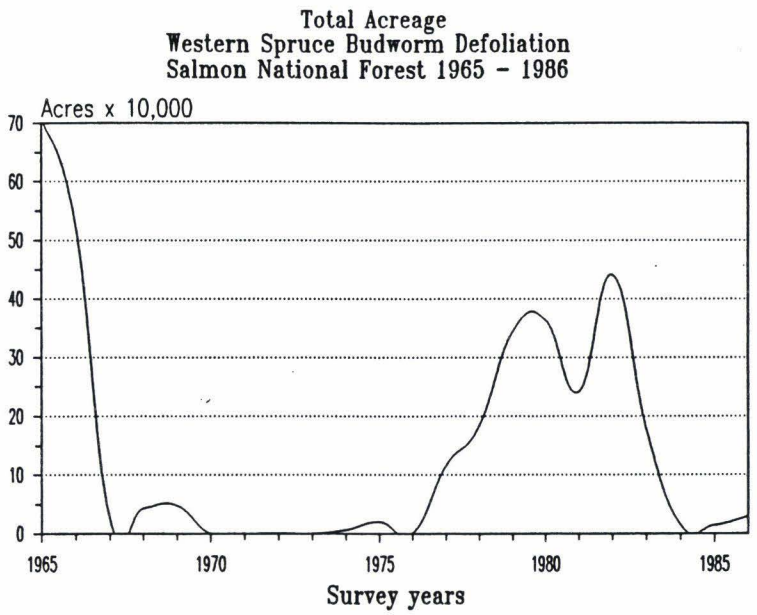
SALMON NATIONAL FOREST

During 1986 conifers on approximately 29,000 acres, twice the acreage reported in 1985, were visibly defoliated. As in 1985 all defoliation was classified as light.

Defoliation on the North Fork Ranger District, primarily of Douglas-fir and subalpine fir, occurred scattered throughout the North Fork of the Salmon River drainage and in host type along the main Salmon River drainage from Cove Creek upstream to North Fork. Elsewhere small isolated infestations in primarily Douglas-fir were observed along Panther Creek on the Cobalt Ranger District, near Goldburg Ridge on the Salmon Ranger District, and along the Beaverhead Mountains on the Salmon and North Fork Ranger Districts.

Field observations indicate that defoliation is present in portions of the Beaverhead and Lemhi Mountains, and throughout areas in the River of No Return Wilderness; these areas are not normally surveyed.

Population sampling indicates that an increase in defoliation intensity may occur on currently infested portions of the Salmon, North Fork, and Cobalt Ranger Districts.



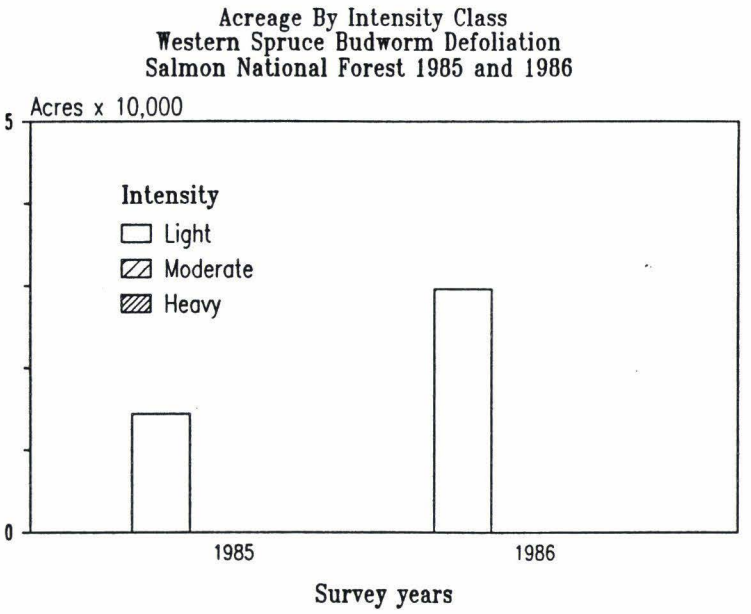


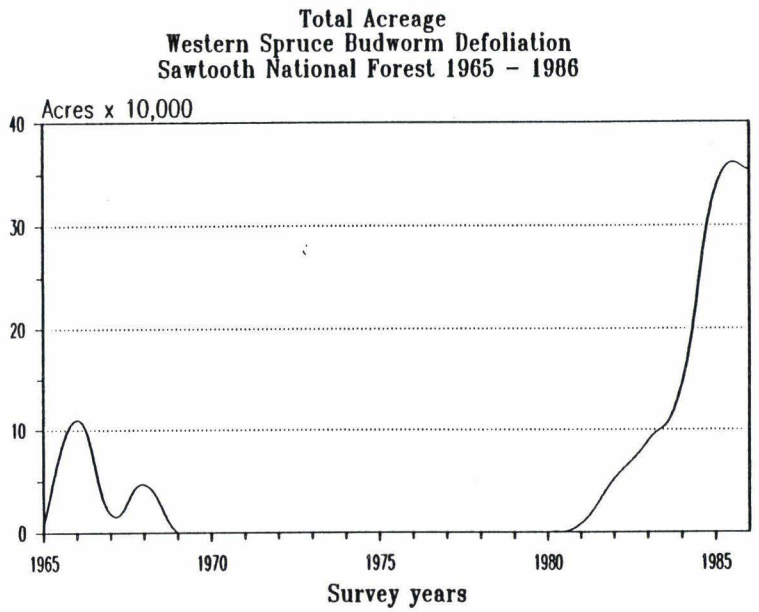
Figure 10. Western spruce budworm activity on the Salmon National Forest

SAWTOOTH NATIONAL FOREST

WSBW activity remained relatively static with Douglas-fir and true fir on approximately 354,000 acres being defoliated during 1986. These hosts on approximately 335,000 acres were defoliated in 1985. Intensity of defoliation decreased Forestwide with increases in defoliation classified as light; moderate and decreases in defoliation classified as heavy.

On the Ketchum Ranger District mostly moderate defoliation occurred throughout the Big Wood River drainage from Galena Summit south to Hailey, along the East Fork of the Wood River, and throughout the Little Wood River Drainage. Light to moderate defoliation was recorded throughout the Bald Mountain Ski area. On the Fairfield Ranger District, moderate to heavy defoliation was recorded throughout the South Fork of the Boise River drainage. Isolated areas of light defoliation were observed along the east side of Sawtooth Valley in the Sawtooth National Recreation Area. On the Burley Ranger District defoliation was mostly moderate to heavy in the Black Pine and Raft River areas.

Population evaluations suggest that defoliation intensity throughout the South Fork of the Boise River drainage (Fairfield Ranger District) should decrease in 1987. Populations in infested areas on the Ketchum and Burley Ranger Districts were not sampled in 1986.



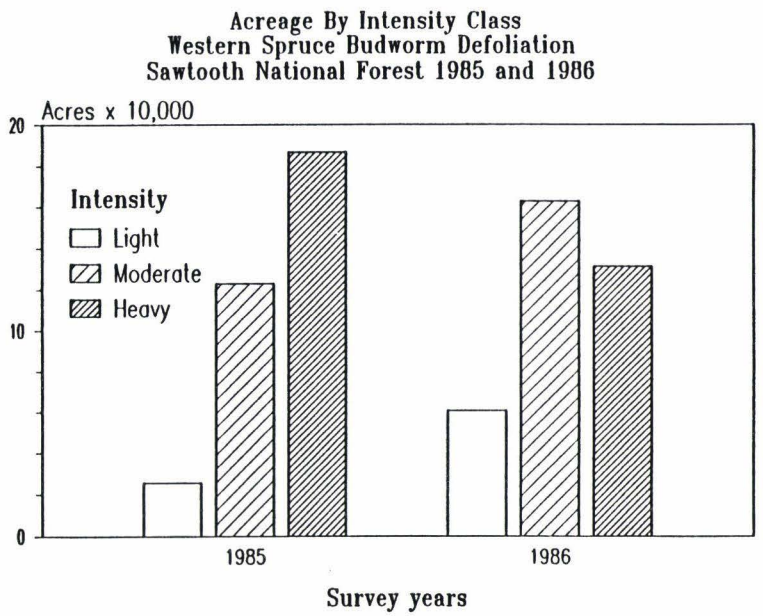


Figure 11. Western spruce budworm activity on the Sawtooth National Forest

Acreage of WSBW activity remained relatively static while defoliation intensity decreased. Conifers on approximately 457,000 acres were visibly defoliated during 1986. Two-thirds of all observed defoliation was classified as heavy in 1985; whereas, in 1986 heavy defoliation was observed on only four percent of the acreage defoliated. This decrease in defoliation intensity occurred Forestwide but was particulary evident in Douglas-fir stands on the Ashton and Island Park Ranger Districts.

Douglas-fir throughout the Centennial Mountains on the Dubois Ranger District sustained light defoliation. Light to moderate defoliation occurred throughout Douglas-fir and subalpine fir on Big Bend Ridge and from Eccles Butte south to Moose Creek Butte on the Ashton and Island Park Ranger Districts. Light to moderate defoliation was also noted along the Teton and Big Hole Mountains on the Teton Basin Ranger District and throughout the Palisades Reservoir area on the Palisades Ranger District. Heavy defoliation occurred near Snake River Butte on the Ashton Ranger District and intermittently throughout the Big Hole Mountains on the Teton Basin and Palisades Ranger Districts.

Based on population sampling, defoliation intensity should continue to decrease throughout the Centennial Mountains on the Dubois Ranger District. Static to decreasing defoliation intensity is predicted for the remainder of the Forest during 1987.

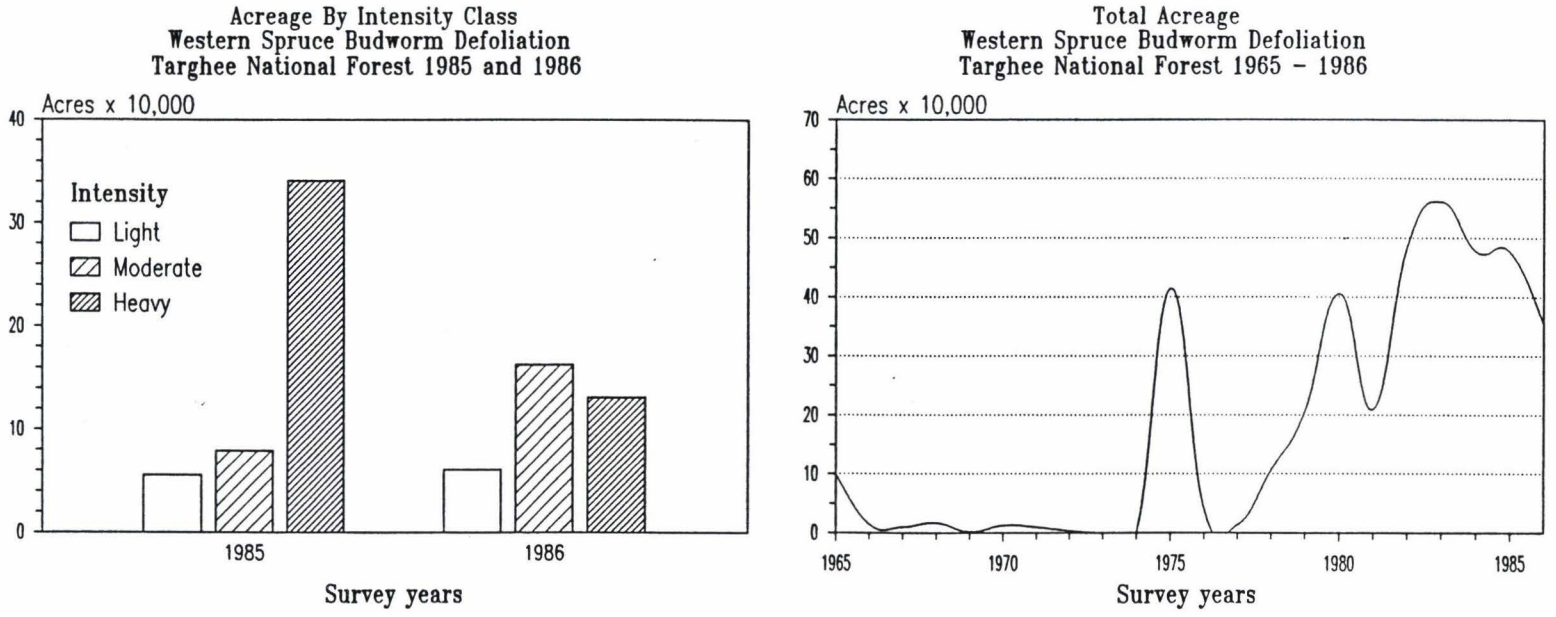


Figure 12. Western spruce budworm activity on the Targhee National Forest

WASATCH-CACHE NATIONAL FOREST

Hosts on approximately 63,100 acres were visibly defoliated in 1986; whereas, hosts on 54,200 acres were defoliated in 1985. Intensity of defoliation decreased with most defoliation being classified as light or moderate.

Major areas of defoliation occurred throughout Logan Canyon. Heavy defoliation was mapped along the Logan River from Tony Grove north to Beaver Mountain Ski area. Topkill and understory mortality were evident in some areas which have sustained several years of heavy defoliation. Light to moderate defoliation was mapped on the northwest side of the Logan River from Green Canyon north to the Forest boundary. Light defoliation occurred in the Left Hand Fork of Blacksmith Fork and was scattered throughout areas between Bear Lake Summit and Temple Peak.

Population sampling was not conducted on the Forest during 1986.

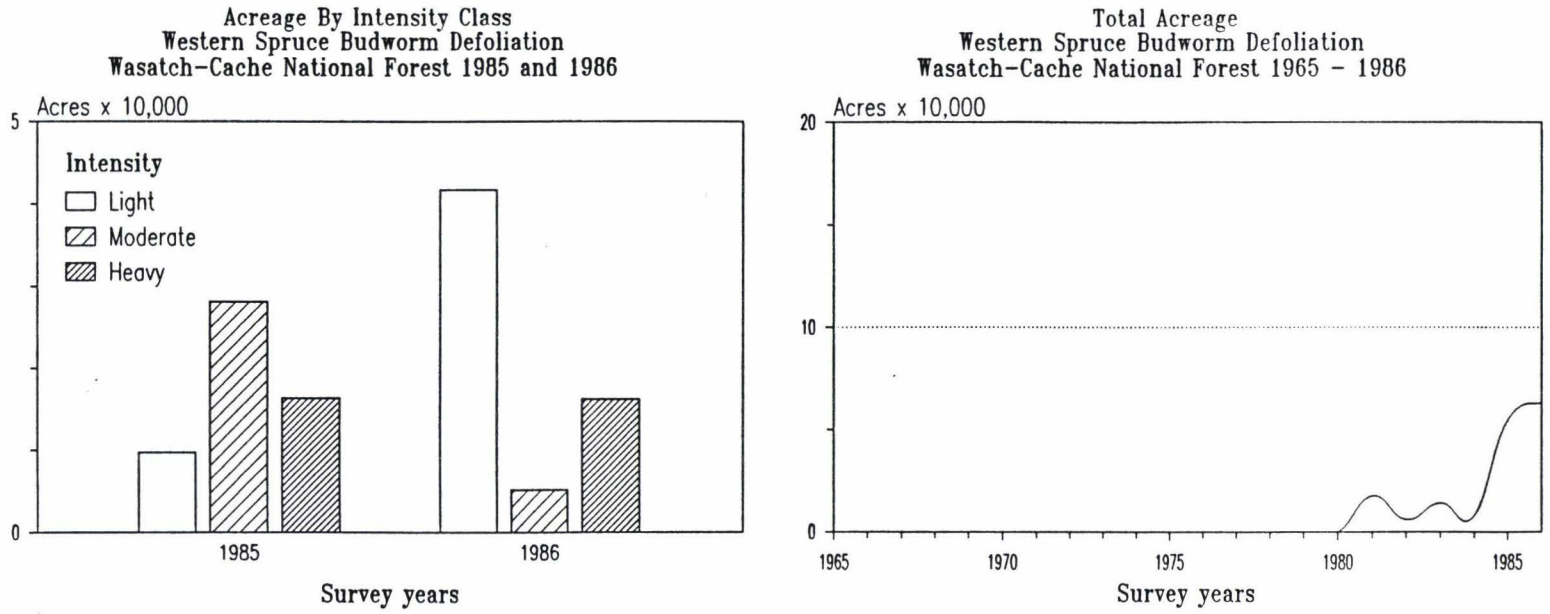


Figure 13. Western spruce budworm activity on the Wasatch-Cache National Forest

MANAGEMENT ALTERNATIVES

No Action: Management alternatives to deal specifically with the pest would not be implemented, and an infestation would be allowed to continue until natural abatement occurs. Short-term resource impacts including growth loss, topkill, some mortality--particulary in the understory and reduced seed production-- would be accepted.

Direct Suppression: One or more available registered insecticides including carbaryl, acephate, malathion, or Bacillus thuringiensis Berliner, a microbial insecticide, would be applied to the entire infestation or to a portion thereof. Approximate costs would be $10 to $15 per acre. Short-term impacts to the various resources would be reduced significantly for a 3 to 4 year period, after which the population would likely return to presuppression levels.

Because treatment would preserve the food base, a chronic infestation could develop, particularly if suppression is undertaken whenever the population resurges to damaging levels.

Silvicultural Management: Stands susceptible to WSBW activity would be managed to reduce potential for damage. Management treatments include:

(1) Favoring a diversity of site-suited, seral, host and non host species

(2) Maintaining or improving stand vigor by conducting timely thinnings and selecting against trees affected with other damage agents including dwarf mistletoe and root/stem decays

(3) Harvesting susceptible stands at maturity using even-age regeneration systems

RECOMMENDATIONS

To deal with WSBW infestations, an integrated approach is recommended with silvicultural management being the base program. Stands with highest resource value and potential for impact should be treated first.

Direct suppression may be considered in high-value young stands and in recreational or seed production areas where short-term protection is desirable and economically feasible.

REFERENCES

Beveridge, R.L.; Cahill, D.B. Western spruce budworm feeding effects on conifers located on the Boise and Payette National Forests. FPM Report 84-7. Ogden, UT: USDA Forest Service, Intermountain Region; 1984. 25p.

Beveridge, R.L.; Knapp, K.A. Detection and dissemination of forest pest data in the Intermountain Region utilizing aerial detection surveys and computer mapping systems. FPM Report 84-8. Ogden, UT: USDA Forest Service, Intermountain Region; 1984. 19p.

Cahill, D.B.; Knapp K.A. The 1984 western spruce budworm conditions in Southern Idaho and predictions for 1985. FPM Report 85-8. Ogden, UT. USDA Forest Service, Intermountain Region; 1985. 10p.

Johnson, P.C.; Denton, R.E. Outbreaks of the western spruce budworm in the American Northern Rocky Mountain area from 1922 through 1971. USDA, Forest Service, Gen. Tech. Report Int-20; 1975. 144p.

Knapp, K.A.; Mocettini, P.J.; Cahill, D.B. The 1985 spruce budworm conditions in southern Idaho and predictions for 1986. FPM Report 86-13. Ogden, UT: USDA Forest Service, Intermountain Region; 1986. 15p.

USDA Forest Service. Status of Forest insect and disease conditions and programs in the Intermountain Region 1972. USDA Forest Service, Intermountain Region, Forest Insect and Disease Control Report; 1972. 12p.

USDA Forest Service. Status of Forest insect and disease conditions and programs in the Intermountain Region 1973. USDA Forest Service, Intermountain Region, Forest Insect and Disease Control Report; 1973. 9p.

USDA Forest Service. Forest insect and disease conditions and programs in the Intermountain Region 1974. USDA Forest Service, Forest Insect and Disease Control Report; 1974. 10p.

USDA Forest Service. Forest insect and disease conditions and programs in the Intermountain Region 1975. USDA Forest Service, Forest Insect and Disease Control Report; 1975. 12p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1976. USDA Forest Service, Forest Insect and Disease Control Report; 1976. 10p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1977. USDA Forest Service, Forest Insect and Disease Control Report; 1977. 13p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1978. USDA Forest Service, Forest Insect and Disease Control Report; 1978. 19p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1979. USDA Forest Service, Forest Insect and Disease Control Report; 1979. 18p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1980. USDA Forest Service, Forest Pest Management Report; 1980. 14p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1981. USDA Forest Service, Forest Pest Management Report; 1981. 24p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1982. USDA Forest Service, Forest Pest Management Report; 1982. 23p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1983. USDA Forest Service, Forest Pest Management Report; 1983. 24p.

USDA Forest Service. Forest insect and disease conditions in the Intermountain Region 1984. USDA Forest Service, Forest Pest Management Report; 1984. 23p.